

EVALUATION OF ROCK REINFORCEMENTS



Project Partners: NHDOT Bureaus of Bridge and Highway Maintenance and Materials & Research, Connecticut DOT, New York State DOT

THE PROBLEM

In 1972 during construction of the Barron Mountain rock cut along I-93 northbound in Woodstock, approximately 70 rock tendons and more than 100 rock bolts were installed to stabilize the cut in response to a major rockslide. Reinforcement systems of this type have a general design life of 50 years.

The current age of the installation and aggressive environmental factors have lead to concerns regarding the long-term integrity of the rock reinforcement system. The Department required geotechnical engineering and technical consulting services to assess the condition of the existing rock reinforcements, to evaluate the remaining service life of the reinforcements, and to formulate an action plan for future monitoring, maintenance, and/or remediation of system elements.

PHASE 1 FINDINGS

- Corrosive ground water and weathered rock environment
- Nondestructive testing indicated:
 - Loss of pre-stress in 30% of sampled rock bolts
 - 10 to 15% loss of cross section
- Tendons in better condition than rock bolts
- Quality of cement grout along tendons more consistent than resin grout along rock bolts
- Estimated remaining service life
 - Rock bolts 15 years
 - Tendon 20 years



Lift-off Test on Existing Bolts



Drilling, Replacing Tendons & Anchors, and Invasive Testing



East View of Rock Cut Along I-93 NB



Over-Coring To Exhume Anchors And Tendons



Over-coring

BENEFITS

The study provided vital information on the condition of the reinforcement system that had previously been unavailable through other methods. The Department now has confidence in the integrity of the rock cut with respect to corrosion. Rehabilitation costs are currently estimated to be significantly lower than the pre-study analysis based on knowing its true condition.

THE OBJECTIVE

To assess the current condition of the rock reinforcements and develop recommendations to preserve or restore its integrity and maintain a safe condition.

PHASE 2 EVALUATION

- NDT results are verified by invasive testing
 - Lift-off tests confirm loss of pre-stress;
 - Physical, chemical and metallurgical testing of steel and grout samples retrieved from exhumed reinforcements
- Rock bolts will not become overstressed from metal loss due to corrosion for another fifteen to twenty years.
- The anchor system of some bolts has degraded.
- Selective bolt replacement recommended within next 5 years.

Photos By Richard Lane



Tendon Protected by Masonry Grout

Heavily Pitted Anchor Bolts



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FOR MORE INFORMATION

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